CLAIMS

1. An information recording medium including a substrate and an information layer arranged on the substrate, the information layer comprising:

a recording layer that is changed in phase reversibly between a crystalline phase and an amorphous phase by at least one of optical means and electrical means; and

at least one crystalline nucleation layer that contains at least one element selected from Bi and Te and at least one element (M1) selected from Sc, Y, La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Yb, and Lu, and is provided in contact with the recording layer.

2. The information recording medium according to claim 1, wherein the crystalline nucleation layer contains at least one selected from Bi(M1) and Te(M1).

3. The information recording medium according to claim 1, wherein the crystalline nucleation layer contains at least one selected from $BiTe(M1)_2$, $Bi_2Te(M1)$, and $BiTe_2(M1)$.

4. The information recording medium according to claim 1, wherein the crystalline nucleation layer contains at least one element selected from N and O.

5. The information recording medium according to claim 1, wherein the recording layer contains at least one element (M2) selected from Sb and Bi, Ge, and Te, and where the element M2, Ge, and Te are represented by a composition formula $Ge_a(M2)_bTe_{3+a}$,

$2 \leq a \leq 50$, and

$2 \leq b \leq 4$ are satisfied.

6. The information recording medium according to claim 5, wherein in the composition formula $Ge_a(M2)_bTe_{3+a}$, at least one element (M3) selected from Sn and Pb is substituted for at least a part of Ge.

7. The information recording medium according to claim 5, wherein in the

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recording layer, the element M2 is Sb, and Bi is substituted for at least a part of Sb.

8. The information recording medium according to claim 7, wherein in the recording layer, a content ratio of Sn atoms is more than 0 atom% and less than 20 atom%.

9. The information recording medium according to claim 7, wherein in the recording layer, a content ratio of Bi atoms is more than 0 atom% and less than 10 atom%.

10. The information recording medium according to claim 1, wherein the recording layer contains at least one element (M2) selected from Sb and Bi, at least one element (M4) selected from Si, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Se, Zr, Nb, Mo, Ru, Rh, Pd, Ag, In, Sn, Ta, W, Os, Ir, Pt, and Au, Ge, and Te, and where the elements M2 and M4, Ge, and Te are represented by a composition formula $(Ge_a(M2)_bTe_{3+a})_{100-c}(M4)_c$,

$2 \leq a \leq 50$,

$2 \leq b \leq 4$, and

$0 < c \leq 20$ are satisfied.

11. The information recording medium according to claim 1, wherein the recording film contains Sb, Te, and at least one element (M5) selected from Ag, In, Ge, Sn, Se, Bi, Au, and Mn, and where Sb, Te, and the element M5 are represented by a composition formula $(Sb_dTe_{100-d})_{100-e}(M5)_e$,

$50 \leq d \leq 95$, and

$0 < e \leq 20$ are satisfied.

12. The information recording medium according to claim 1, wherein the crystalline nucleation layer has a thickness not less than 0.2 nm and not more than 3 nm.

13. The information recording medium according to claim 1, wherein the recording layer has a thickness not less than 3 nm and not more than 14 nm.

14. The information recording medium according to claim 1, the medium having a multi-layer structure in which a first to an N-th information layers

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(N represents a natural number not smaller than 2) are laminated, wherein at least one of the first to N-th information layers is the information layer.

15. The information recording medium according to claim 1,

wherein the recording layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of a laser beam, and

the information layer further comprises a dielectric layer provided on both sides of a laminated body formed of the recording layer and the crystalline nucleation layer, and a reflective layer arranged on a side opposite to an incident side of the laser beam with respect to the laminated body.

16. The information recording medium according to claim 15, wherein the information layer further comprises a light absorption correction layer arranged between the laminated body and the reflective layer.

17. The information recording medium according to claim 1,

wherein the recording layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of a laser beam, and

the information layer comprises at least a first dielectric layer, a second dielectric layer, the crystalline nucleation layer, the recording layer, a third dielectric layer, and a reflective layer in this order from an incident side of the laser beam.

18. The information recording medium according to claim 1,

wherein the recording layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of a laser beam, and

the information layer comprises at least a first dielectric layer, a second dielectric layer, the recording layer, the crystalline nucleation layer, a third dielectric layer, and a reflective layer in this order from an incident side of the laser beam.

19. The information recording medium according to claim 1,

wherein the recording layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of a laser beam, and

the information comprises at least a first dielectric layer, a second dielectric layer, the crystalline nucleation layer, the recording layer, the crystalline nucleation layer, a third dielectric layer, and a reflective layer in

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this order from an incident side of the laser beam.

20. The information recording medium according to any one of claims 17 to 19, wherein the information layer further comprises a fourth dielectric layer provided between the third dielectric layer and the reflective layer.

21. The information recording medium according to any one of claims 17 to 19, wherein the information layer further comprises an interface layer that is provided between the third dielectric layer and the reflective layer and has a thermal conductivity lower than that of the reflective layer.

22. The information recording medium according to claim 1, the medium having a multi-layer structure in which a first to an N-th information layers (N represents a natural number not smaller than 2) on which information is recorded by irradiation of a laser beam are laminated in this order from an incident side of the laser beam,

wherein at least the first information layer is the information layer,

the recording layer included in the first information layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of the laser beam, and

the first information layer comprises at least a first dielectric layer, a second dielectric layer, the crystalline nucleation layer, the recording layer, a third dielectric layer, a reflective layer, and a transmittance adjusting layer in this order from the incident side of the laser beam.

23. The information recording medium according to claim 1, the medium having a multi-layer structure in which a first to an N-th information layers (N represents a natural number not smaller than 2) on which information is recorded by irradiation of a laser beam are laminated in this order from an incident side of the laser beam,

wherein at least the first information layer is the information layer,

the recording layer included in the first information layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of the laser beam, and

the first information layer comprises at least a first dielectric layer, a second dielectric layer, the recording layer, the crystalline nucleation layer, a third dielectric layer, a reflective layer, and a transmittance adjusting layer in

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this order from the incident side of the laser beam.

24. The information recording medium according to claim 1, the medium having a multi-layer structure in which a first to an N-th information layers (N represents a natural number not smaller than 2) on which information is recorded by irradiation of a laser beam are laminated in this order from an incident side of the laser beam,

wherein at least the first information layer is the information layer,

the recording layer included in the first information layer is changed in phase reversibly between a crystalline phase and an amorphous phase by irradiation of the laser beam, and

the first information layer comprises at least a first dielectric layer, a second dielectric layer, the crystalline nucleation layer, the recording layer, the crystalline nucleation layer, a third dielectric layer, a reflective layer, and a transmittance adjusting layer in this order from the incident side of the laser beam.

25. The information recording medium according to any one of claims 22 to 24, wherein the transmittance adjusting layer contains at least one selected from TiO_2, ZrO_2, ZnO, Nb_2O_5, Ta_2O_5, SiO_2, Al_2O_3, Bi_2O_3, Cr_2O_3, Sr–O, Ti–N, Zr–N, Nb–N, Ta–N, Si–N, Ge–N, Cr–N, Al–N, Ge–Si–N, Ge–Cr–N, and ZnS.

26. The information recording medium according to claim 20, wherein the fourth dielectric layer contains $(ZnS)_{80}(SiO_2)_{20}$.

27. The information recording medium according to any one of claims 17 to 25, wherein the third dielectric layer is formed of an oxide-fluoride-based material containing at least one selected from HfO_2 and ZrO_2, SiO_2, Cr_2O_3, and a fluoride.

28. The information recording medium according to claim 27, wherein the fluoride contains at least one selected from CeF_3, ErF_3, GdF_3, LaF_3, TbF_3, DyF_3, NdF_3, YF_3, and YbF_3.

29. The information recording medium according to claim 27, wherein where the oxide-fluoride-based material is represented by a composition formula $(HfO_2)_{A1}(SiO_2)_{B1}(Cr_2O_3)_{C1}(\text{fluoride})_{100-A1-B1-C1}$ or

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$(ZrO_2)_{A1}(SiO_2)_{B1}(Cr_2O_3)_{C1}$ (fluoride)$_{100-A1-B1-C1}$,

A1, B1, C1, and A1 + B1 + C1 satisfy:

$10 \leq A1 \leq 50$;

$10 \leq B1 \leq 50$;

$10 \leq C1 \leq 50$; and

$50 \leq A1 + B1 + C1 \leq 90$, respectively.

30. The information recording medium according to any one of claims 17 to 25, wherein at least one of the second dielectric layer and the third dielectric layer is formed of an oxide-based material containing at least one selected from HfO_2 and ZrO_2, SiO_2, and Cr_2O_3.

31. The information recording medium according to claim 29, wherein where the oxide-based material is represented by a composition formula $(HfO_2)_{A2}(SiO_2)_{B2}(Cr_2O_3)_{100-A2-B2}$ or $(ZrO_2)_{A2}(SiO_2)_{B2}(Cr_2O_3)_{100-A2-B2}$,

A2, B2, and A2 + B2 satisfy:

$10 \leq A2 \leq 50$;

$10 \leq B2 \leq 50$; and

$20 \leq A2 + B2 \leq 80$, respectively.

32. A method for manufacturing an information recording medium that is provided with at least one information layer on a substrate,

wherein a step of forming the information layer comprises:

a step of forming a recording layer that is changed in phase reversibly between a crystalline phase and an amorphous phase by at least one of optical means and electrical means; and

a step of forming a crystalline nucleation layer by performing sputtering using a sputtering target containing at least one element selected from Bi and Te and at least one element (M1) selected from Sc, Y, La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Yb, and Lu, and

the step of forming the recording layer and the step of forming the crystalline nucleation layer are performed sequentially.

33. The method for manufacturing an information recording medium according to claim 32, wherein the sputtering target contains at least one selected from Bi(M1) and Te(M1).

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34. The method for manufacturing an information recording medium according to claim 32, wherein the sputtering target contains at least one selected from $BiTe(M1)_2$, $Bi_2Te(M1)$, and $BiTe_2(M1)$.

35. The method for manufacturing an information recording medium according to claim 32, wherein in the step of forming the crystalline nucleation layer, at least one selected from Ar gas, Kr gas, a mixture of Ar gas and a reactive gas, and a mixture of Kr gas and a reactive gas is used in performing sputtering, the reactive gas being at least one selected from N_2 gas and O_2 gas.

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